(12) AUSTRALIAN PATENT ABRIDGMENT
(FOLLOWING MODIFIED EXAMINATION BASED ON US PATENT NO. 4595624)

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(54)	SECURITY GLAZING		
(71)	THE POST OFFICE		
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(56)	US 4130684 US 3904460 EP 3432		

(57) Claim

1. A security glass consisting essentially of a plurality of layers of glass of at least three thicknesses, and a plurality of layers of flexible bonding material disposed alternatingly to form a laminate of greater tensile strength than the glass; wherein a layer of the flexible bonding material possesses the greater or greatest thickness of any of the layers of flexible bonding material and is positioned such that it is not the layer of flexible bonding material which is forwardmost in relation to the direction of expected impact, and wherein said laminate includes a rearmost glass layer no more than 2 mm thick which is thinner than the glass layers forward thereof, which possesses a thickness of from 40-80% of the thickness of the next thickest glass layer and which is chemically-toughened so that said laminate substantially resists spalling from the rearmost surface when subject to impact on the front-most surface.

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COMMONWEALTH OF AUSTRALIA 562000

Patents Act 1952–1969

Form 10

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE:

Class | Int. Class

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Complete Application No. :

Specification Lodged :

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TO BE COMPLETED BY APPLICANT

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Complete Specification for the invention entitled: "~~IMPROVEMENTS IN OR RELATING TO~~ SECURITY GLAZING"

The following statement is a full description of this invention, including the best method of performing it known to ~~me~~ us.

it to be termed "bullet-resistant" glass. For this purpose it will need to be able to withstand ballistic attack, the grade of glass chosen being matched to specific weapons likely to be employed. British Standard 5051 covers bullet resistant glass laminates ranging in thickness from 25 mm to 78 mm.

Glass is amorphous, i.e. from a strictly scientific point of view it can be considered to be a liquid at normal temperatures, albeit in a very viscous form. It is therefore not surprising perhaps to find that as an engineering material it has very peculiar properties. It is very brittle and has a high compressive strength. Moreover studies of its tensile strength when it is in a thin filament form such as in glass fibres-reinforced plastics sheets or mouldings suggest that even when in the filament form, the full tensile strength potential of a glass is not realised. Investigations show that glass behaves as though there were fine cracks in its surface even when the surface is known to be highly polished and completely free of such cracks. This oddity has never satisfactorily been explained although it usually does not give rise to difficulties when glass is used for conventional glazing, but the picture is different with security glazing. Thus, a major problem with security glazing whether manufactured as anti-bandit or anti-ballistic glazing, is that while it is possible to design a screen which withstands the force of repeated impact with heavy implements, all determined attacks produce spall off the rear face of the screen glazing. The spall which consists of glass slivers and fragments can travel at high velocity through the air for some considerable distance during an attack. Hence spall is very dangerous and can seriously lacerate the face of a counter clerk or bank teller standing about 1 metre behind the glass. Indeed even minute slivers of glass can seriously harm the eyesight.

attack.

2. The further such a layer is placed towards the rear face, that is away from the attack face, the greater its effect on the resistance of glazing.

From engineering structural considerations, this invention utilises the high compressive strength of glass in a position in the laminate where the compressive forces are most intense during an attack; the flexible bonding material is located where tensile forces occur. It has been observed that to be most effective, the major part of the flexible bonding material should be placed as a layer towards the rear of the laminate. Indeed, by means of a symmetrical arrangement of alternating glass and flexible bonding material layers, it is possible to produce a laminate of say 5 or 7 glass layers with the central layer of flexible bonding material being thicker than outer layers of flexible material. Hence a lamination with high resistance to attack in both directions or having superior resistance to ballistic attack results.

According to a preferred feature of the invention, the laminate possesses a rearmost glass layer which is chemically toughened and indeed in general the rearmost glass layer is preferably thin in relation to the other glass layers. Not only has it been observed that when a rearmost glass layer of an inventive laminate is thin, spall formation is reduced and that the formation of this thin glass layer from chemically toughened glass produces minimum spall without sliver formation and has the advantage of considerably increasing the overall strength of the glazing, but more particularly, thin usually chemically toughened glass acts as a tensile element producing superior attack resistance. Such a thin final layer of chemically toughened glass which may be employed in the practice of the present invention is flexible because of its

chemically toughened glass sheet. Between the adjacent pairs of glass sheets are polyvinylbutyral layers. The pvb layer between glass sheets 1 and 3 possesses a thickness of 0.76 mm, that between glass sheets 5 and 7 possesses a thickness of 0.38 mm. However the central pvb layer possesses a considerably greater thickness of 2.28 mm. It has been found that this combination of chemically toughened relatively thin rearmost glass sheet and thick pvb layer at a position remote from the front of the glazing serves to produce a glass laminate of superior impact resistance and freedom from spall formation when subject to impact with a heavy instrument.

Referring to Figures 2 and 3, the test arrangement shown there is designed to simulate conditions which would be encountered at a bank or post office counter in the event of an attempt by bandits to break through security glazing either in terrorising staff or to enable them to have physical access to the staff side of the counter. Thus a glass test panel 11 is held in a test rig 12 so as to remain upright even when subject to impacts. Spall collection trays A, B and C lie in turn behind the test panel 11, each having a width of 390 mm with the combined width of 1150 mm simulating the depth of a bank counter. Spall collection trays D are stacked at a position likely to be occupied by a counter clerk and serve to collect spall which has flown through the air rather than merely fallen towards one of the collection trays. One of the trays D is covered by a witness paper 13 which is intended to simulate the face of a counter clerk during an attack on the test panel 10. The clamped test panel has a width of about 1 metre.

The following non-limiting Example illustrates this invention:-

<u>EXAMPLE</u>

A series of experiments was carried out utilising

rigorous than those imposed normally on security glazing in British Crown Post Offices which merely require that the glass should not spring out of its frame after an attack lasting 20 seconds with a 1.12 kg (2.5lb) hand hammer.

Tables 2 and 3 show the test results obtained. Table 2 indicates whether there was any spall formation on the first impact and then indicates the number of blows applied during the subsequent 20 second and 40 second impact periods, followed by an indication of the number of blows and the overall impact time involved before penetration occurred.

Table 3 shows in grams the number of grams of spall collected in trays A, B, C and D (combined) in the test arrangement shown in Figures 2 and 3 of the accompanying drawings.

Table 2

Test No.	1st Blow Spall	No. of Blows 2-19 secs.	No. of Blows 20-60 secs.	To Penetration	
				No. of Blows	Times
1	Yes	13	26	(13)14	(17)18*
2	Yes	17	33	21	22
3	Yes	11	26	12	16
4	No	15	25	23	30
5	Yes	12	28	(18)19	(27)28*
6	Yes	14	25	21	27
7	Yes	14	30	10	12
8	Yes	14	27	9	12
9	No	14	28	8	10
10	Yes	14	26	24	33
11	No	12	28	41	60
12	Yes	14	23	(25)28	(26)40*
13	No	15	29	No Penetration	
14	Yes	14	26	(14)15	(20)21*
15	Yes	14	21**	5	5
16	Yes	14	22**	4	4
17	Yes	18	29	(16)(12)17	(6)(17)18*
18	Yes	14	30	5	6
19	Yes	14	30	8	10
20	Yes	14	27	6	6
21	Yes	14	23	16	21
22	Yes	9	22	(4) 5	(5) 6*
23	Yes	13	29	12	16
24	Yes	14	29	8	9
25	Yes	13	28	8	10

Table 3

Test No.	Spall Weights A	B	C	D
1	258	80	150	62
2	252	260	178	137
3	112	134	118	71
4	30	30	29	23
5	96	100	58	39
6	54	39	28	19
7	393	233	179	145
8	175	149	73	60
9	134	82	59	41
10	25	27	27	13
11	13	19	21	19
12	54	67	68	65
13	No Measurable Spall			
14	47	28	33	39
15	No Measure of Spall taken for this test			
16	204	220	187	130
17	180	93	80	50
18	222	208	247	214
19	223	123	139	78
20	170	80	71	86
21	97	162		57
22	90	72	61	40
23	78	73	70	45
24	121	87	82	59
25	97	68	40	26
26	182	172	124	69
27	325	240	289	174
28	179	116	86	59
29	49	43	39	24
30	260	295	309	175
31	181	113	81	69
32	53	65	76	53
33	103	120	108	62
34	103	158	205	142

thinnest pvb layer, the thickness of which pvb layer is indeed preferably at least three times that of the next thickest pvb layer.

5. The security glass of claim 1 wherein the laminate has a symmetrical structure with the said layer of flexible bonding material of greater or grestest thickness being centrally positioned and equal numbers of layers of glass and of flexible bonding material being positioned on either side thereof.

6. The security glass of claim 1 wherein the rearmost glass layer has a thickness of from 16% to 40% of the thickness of the thickest glass layer.

Dated this 26th day of November, 1986.

THE POST OFFICE,
by their Patent Attorneys,
COLLISON & CO.

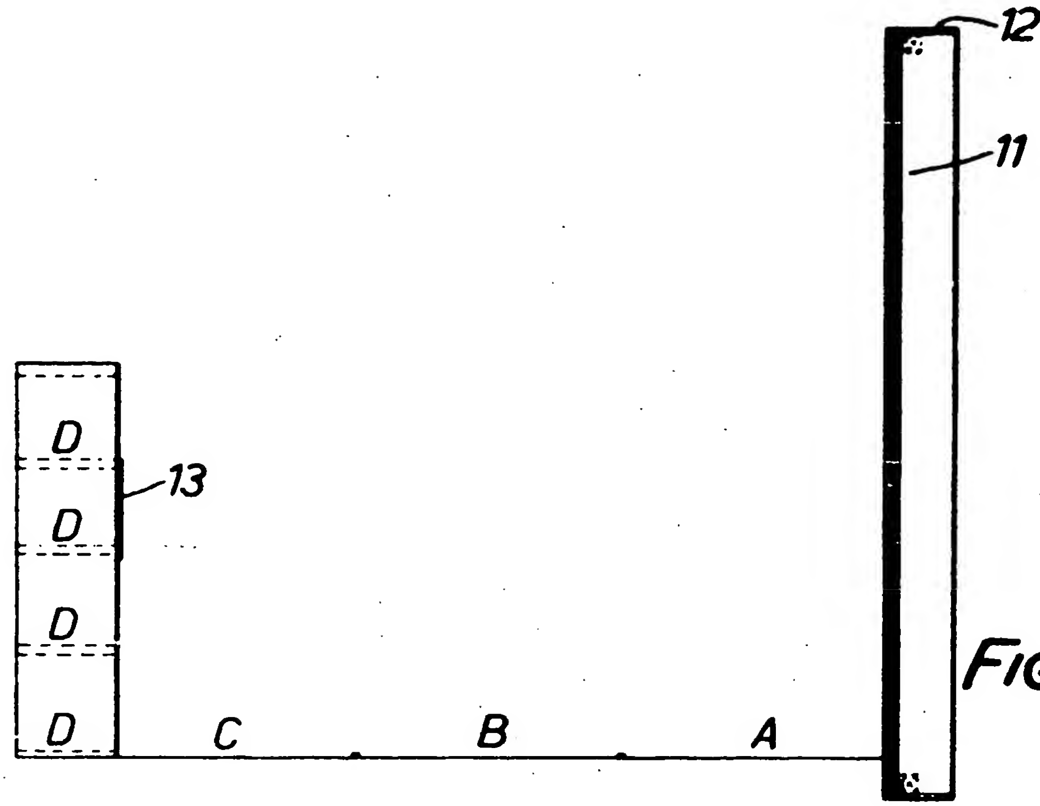

FIG. 2.

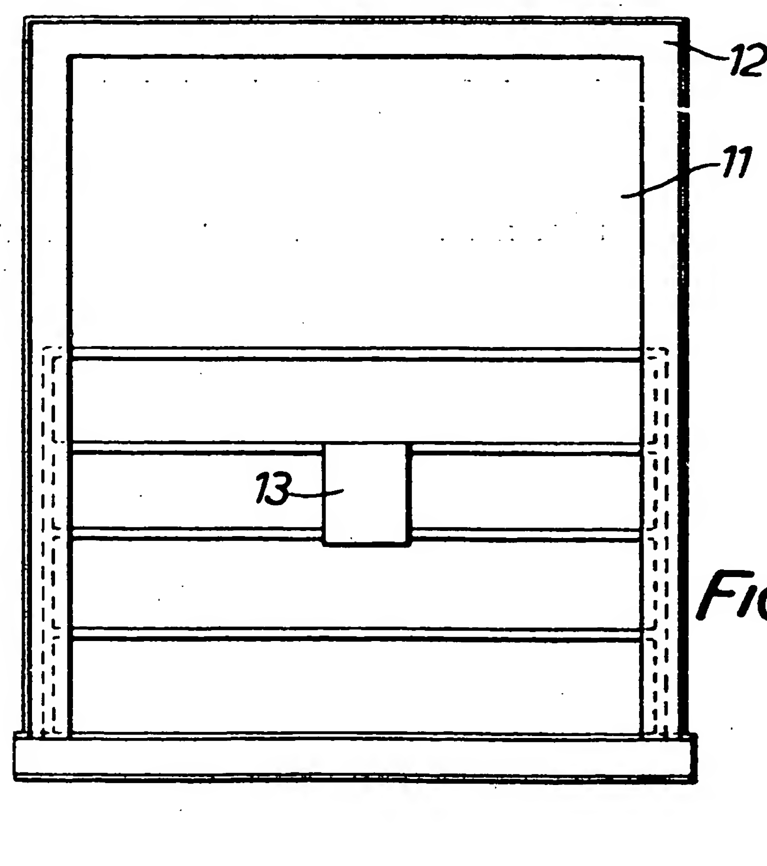

FIG. 3.